PCT

WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 : C03C 27/12, B32B 17/10, 31/04, 31/26

A1

(11) International Publication Number: WO 98/40324

(43) International Publication Date: 17 September 1998 (17.09.98)

(21) International Application Number: PCT/AU98/00150

(22) International Filing Date: 11 March 1998 (11.03.98)

(30) Priority Data:
PO 5546 11 March 1997 (11.03.97) AU

(71) Applicant *(for all designated States except US)*: PILKINGTON (AUSTRALIA) LIMITED [AU/AU]; 95 Greens Road, Dandenong, VIC 3175 (AU).

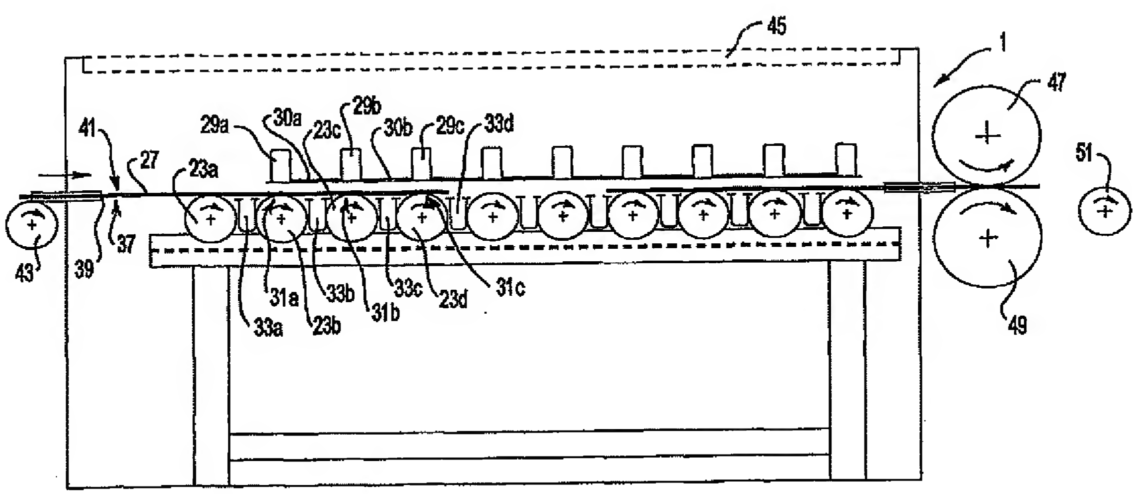
(72) Inventors; and
(75) Inventors/Applicants *(for US only)*: DAVIES, Edward, Derek [AU/AU]; 27 Roborough Avenue, Mount Eliza, VIC 3930 (AU). HOYLE, Rodney [AU/AU]; 2 Oxford Street, Mount Waverley, VIC 3149 (AU). CURRIE, David, Cowan [GB/AU]; 214 Waterfall Gully Road, Rosebud, VIC 3939 (AU).

(74) Agent: PHILLIPS ORMONDE & FITZPATRICK; 367 Collins Street, Melbourne, VIC 3000 (AU).

(81) Designated States: AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GE, GH, GM, GW, HU, ID, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).

Published
With international search report.

(54) Title: LAMINATED GLASS AND METHOD



(57) Abstract

A method for manufacturing a glass laminate structure comprising: a) providing an assembly including first and second glass sheets having therebetween an interlayer of polymeric material capable of being selectively heated, said sheets and interlayer being in a parallel "sandwich" arrangement; b) passing said assembly through a heating zone whereby said assembly is exposed to electromagnetic radiation of a frequency or frequencies to selectively heat said interlayer to a fluid state; and c) passing said heated assembly through press means to effect laminating of said first and second sheets while said interlayer is still in a fluid state. The present invention produces a laminate which complies with commercially acceptable standards, i.e. clarity, impact resistance, bond strength without the need for the additional steps of autoclaving the structure or subjecting the structure to reduced pressure.

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	ES	Spain	LS	Lesotho	SI	Slovenia
AM	Armenia	FI	Finland	LT	Lithuania	SK	Slovakia
AT	Austria	FR	France	LU	Luxembourg	SN	Senegal
AU	Australia	GA	Gabon	LV	Latvia	SZ	Swaziland
AZ	Azerbaijan	GB	United Kingdom	MC	Monaco	TD	Chad
BA	Bosnia and Herzegovina	GE	Georgia	MD	Republic of Moldova	TG	Togo
BB	Barbados	GH	Ghana	MG	Madagascar	TJ	Tajikistan
BE	Belgium	GN	Guinea	MK	The former Yugoslav Republic of Macedonia	TM	Turkmenistan
BF	Burkina Faso	GR	Greece			TR	Turkey
BG	Bulgaria	HU	Hungary	ML	Mali	TT	Trinidad and Tobago
BJ	Benin	IE	Ireland	MN	Mongolia	UA	Ukraine
BR	Brazil	IL	Israel	MR	Mauritania	UG	Uganda
BY	Belarus	IS	Iceland	MW	Malawi	US	United States of America
CA	Canada	IT	Italy	MX	Mexico	UZ	Uzbekistan
CF	Central African Republic	JP	Japan	NE	Niger	VN	Viet Nam
CG	Congo	KE	Kenya	NL	Netherlands	YU	Yugoslavia
CH	Switzerland	KG	Kyrgyzstan	NO	Norway	ZW	Zimbabwe
CI	Côte d'Ivoire	KP	Democratic People's Republic of Korea	NZ	New Zealand		
CM	Cameroon			PL	Poland		
CN	China	KR	Republic of Korea	PT	Portugal		
CU	Cuba	KZ	Kazakstan	RO	Romania		
CZ	Czech Republic	LC	Saint Lucia	RU	Russian Federation		
DE	Germany	LI	Liechtenstein	SD	Sudan		
DK	Denmark	LK	Sri Lanka	SE	Sweden		
EE	Estonia	LR	Liberia	SG	Singapore		

LAMINATED GLASS AND METHOD

The present invention relates to the manufacture of glass in particular the manufacture of laminated glass. It will be convenient to describe the invention with particular reference to flat glass laminate structures although it will be appreciated that the invention may have wider application

Background of the Invention

Laminated glass is used widely in many fields, particularly in the building and automotive industry where the safety of glass products is imperative.

The most commonly used process for manufacturing laminated glass is in a batch process. First, a cleaned sheet of glass which has been cut to the desired size is overlaid with a polymeric interlayer, generally made of polyvinylbutyrate (PVB), and another layer of cleaned glass cut to the same size as the first layer is applied on the top of the PVB interlayer. The laid-up laminate structure is then passed on a conveyor through a heating zone where infra-red heating elements heat the glass sufficiently to cause at least partial softening of the PVB layer by a combination of direct radiation and conduction of heat through the glass layers. The heated laminate assembly is then passed through a press while the PVB is still partially softened to remove excess air. As the surface of the PVB interlayer is slightly textured, at this stage it does not completely adhere to both the adjacent surfaces of the glass sheets and there are numerous tiny air pockets trapped between the two glass sheets. This gives the laminate structure an opaque appearance which is highly undesirable in the finished product. The assembly is then transferred to an autoclave where it is subjected to temperatures of generally between 120°C to 150°C and pressure of up to about 1000 kPa for a short dwell period (typically 20-30 minutes) to dissolve any entrapped air into the softened PVB layer. The complete cycle, ie. heating, pressurization, dwell and cooling can take several hours depending upon load size and type of laminate. Typical cycles are between 3½ to 4

hours duration.

This conventional process for manufacturing laminated glass has a number of disadvantages. First, the process is both capital intensive (autoclaves being expensive) and energy intensive. The laid-up structure is subjected to a first heating step, followed by a second heating step. The structure will cool between the two steps thus losing energy applied during the first step which must then be re-applied during the second step. Secondly, the autoclaving step must be performed on a batch basis and involves significant handling of product and time delays while a full load for the autoclave is prepared which further adds to costs and increases the time it takes to fulfil an order. The process consumes relatively high amounts of energy to soften the PVB interlayer as this is done by conduction of heat through the glass layers when all that really needs to be heated is the PVB interlayer.

In another known process, the laid-up structure is heated with a vacuum ring around the periphery of the structure, whereas reduced pressure is applied at the edge of the structure to remove air from between the interlayer and the glass.

Other methods of producing laminated glass include the "resin pour" method. Instead of using a sheet of PVB interlayer a curable resin is poured between sheets of glass and the resin in then cured giving a solid clear interlayer. This method is, also known as the "cast-in-place" or "PECTOR process" is more labour intensive and does not enable the large scale of production available through the use of a PVB interlayer.

It has been proposed to use alternative arrangements to heat the PVB interlayer.

Australian Patent Application 81771/87 discloses a process and apparatus for the production of laminated glass where a laminate assembly of two parallel glass sheets is assembled and a localised heating zone is provided across which the assembly to be laminated passes. The heating

zone in 81771/87 is provided by one or more microwave transmitting horn antennas arranged across the assembly in a narrow heating zone. A disadvantage of such an arrangement is that the horn radiator, which is a directional focussing device, will produce a hot spot at a zone where the intensity of microwave radiation is at a maximum and a cold zone surrounding the hot spot where no radiation is present. The result is an uneven distribution of microwave energy across the PVB layer resulting in uneven heating of the PVB. Furthermore, with localised heating there is an increased chance of a temperature differential between the PVB interlayer and glass layers which could cause the glass to fracture. Furthermore, there is a need for a method of manufacturing laminated glass which is cost and energy efficient, can be performed on a continuous basis rather than on a batch basis and satisfies the performance criteria for laminated glass in terms of clarity, bond adhesion strength, and fracture strength as well as being within prescribed safety limits for microwave emission.

It is an object of the present invention to provide a method and/or apparatus which overcomes or alleviates at least one of the problems of the prior art.

Summary of the Invention

In accordance with one aspect of the present invention there is provided a method for manufacturing a glass laminate structure comprising:

a) providing an assembly including first and second glass sheets having therebetween an interlayer of polymeric material capable of being selectively heated, said sheets and interlayer being in a parallel "sandwich" arrangement;

b) passing said assembly through a heating zone whereby said assembly is exposed to electromagnetic radiation of a frequency or frequencies to selectively heat said interlayer to a fluid state; and

c) passing said heated assembly through press means to effect laminating of said first and second sheets while said interlayer is still in

a fluid state.

The present invention produces a laminate which complies with commercially acceptable standards ie clarity, impact resistance, bond strength without the need for the additional steps of autoclaving the structure or subjecting the structure to reduced pressure. The invention adequately removes or dissolves air in the structure and bonds the glass sheets in one pass rather than requiring additional processing steps to perform this.

In a preferred embodiment the heating zone consists of a plurality of waveguides emitting microwave radiation, said waveguides being spaced from each other in the direction of travel of said assembly and extending across the width of said assembly.

A laminate structure is first laid up by providing a first glass sheet and overlaying it with an interlayer of polymeric material which is capable of being selectively heated and softened by electromagnetic radiation and then laying a second glass sheet on top of said interlayer to form a parallel laminate assembly. The glass sheets may be of any suitable size or shape provided that they are no wider than the heating zone through which they pass. The glass sheets may be substantially flat as may be desired for use as conventional window or door laminate glass. Alternatively the glass sheets may be curved, for example for use in automotive windscreens or windows, or for particular architectural applications where curved laminated glass is desired.

Conventional laminated glass for architectural use is generally made from two sheets of glass 3mm thick and a PVB interlayer .38mm thick while thinner glass sheets are normally employed when the laminate is required for automotive use. It will be appreciated that different thicknesses of glass and interlayer may be utilised although adjustments to the power requirements of the electromagnetic radiation source, waveguides and transport speed of the laminate structure, amongst other things, may need

to be varied accordingly.

The laminate assembly is then passed through a heating zone which selectively heats the interlayer but does not to any significant extent directly heat the glass sheets. Although the glass sheets may be heated by conduction from the interlayer once the interlayer is heated, the electromagnetic radiation selected to perform the heating is such that it acts to heat directly only the interlayer. The preferred form of electromagnetic radiation is microwave radiation.

The heating zone preferably consists of a plurality of electromagnetic radiation emitting waveguides spaced from each other in the direction of travel of the laminate assembly. As the laminate structure travels through the heating zone the polymeric layer is heated to a temperature where plastic flow occurs. Selective heating of the interlayer in preference to the glass is achieved by selecting a frequency so that the interlayer absorbs more energy than the glass. It will be apparent that the method may be readily adapted to alternative compositions of glass.

By utilising a plurality of waveguides spaced from each other in the direction of travel of the laminate assembly, heating of the interlayer can occur over a relatively large area of the assembly over a preferred duration. Furthermore, gradual heating generally leads to more even heating of the interlayer and therefore increased uniformity in the finished laminate structure.

After the interlayer has been heated to its desired laminating temperature which at the glass surface is generally between 80° and 105°C, the laminate assembly is passed through press means. The press means acts to force any trapped air to be absorbed into the interlayer so that gas bubbles do not appear in the finished product which would decrease clarity of the laminated glass and effects lamination of the two glass sheets.

As the present invention acts to heat the interlayer selectively over the glass sheets, rather than the glass sheets heating the interlayer by

conduction, significant energy savings can be achieved.

In another embodiment of the invention there is provided a laminated glass structure including first and second sheets laminated together by a polymeric interlayer, said structure having been manufactured by a method of the invention previously described.

In another aspect of the invention there is provided apparatus for manufacturing a glass laminate structure including:

at least one source of electromagnetic radiation capable of selectively heating a polymeric interlayer material;

a plurality of waveguides traversing a heating zone in a cross machine direction and spaced from each other along a machine direction in said heating zone, said waveguides carrying a travelling wave of electromagnetic radiation from said source and having means for emission of said radiation from said waveguides into said heating zone;

means for transporting a laminate structure in a machine direction through said heating zone; and

press means beyond said heating zone to press said laminate structure after passage through said heating zone.

In a preferred embodiment the electromagnetic radiation is microwave radiation and the source of microwave radiation is a magnetron or plurality of magnetrons although other sources such as one or more klystrons may alternatively be used. The advantages of using magnetrons are that they are readily commercially available, and are generally highly reliable and efficient. Preferably the magnetrons generate microwave radiation having a frequency of about 2.45GHz although it is within the scope of the invention to use other microwave frequencies if desired. The source of microwave radiation may have a variable power control to adjust the intensity of the radiation generated in the heating zone.

The plurality of waveguides traverse a heating zone in a cross machine direction, or in other words in a direction substantially perpendicular to the

direction in which a laminate assembly travels through the apparatus. Each waveguide may be provided with a separate source of electromagnetic radiation. Alternatively, the waveguides may be coupled in a region outside the heating zone so that radiation propagated by the source and one end of a waveguide can be re-directed down another waveguide to pass across the heating zone again. The waveguides may be commercially available rectangular waveguides such as WR.340 waveguides. In one embodiment, waveguides may be provided above and below the heating zone. In this arrangement the waveguides are preferably arranged in a staggered manner in the machine direction such that an upper waveguide is not directly above a lower waveguide. In a preferred embodiment alternate waveguides have the source of electromagnetic radiation positioned at alternate sides of the heating zone in order that a more even field strength is achieved throughout the heating zone.

The waveguides have means for emission of the radiation from the waveguide. Preferably, the emission means consists of a longitudinal aperture extending along the waveguide in the region of the waveguide facing the heating zone. When a travelling wave is propagated by a microwave source and carried along a waveguide, a proportion of the electromagnetic energy is emitted from the aperture and radiates into the heating zone. The dimensions of the aperture may be varied depending upon the desired field strength requirements necessary in the heating zone and the configuration of the aperture shape may be varied as desired to vary the electromagnetic energy density. Furthermore, the dimensions of the aperture may be varied to adjust the width of the heating zone to allow for varying widths of laminate assembly to be heated thus reducing energy losses. For example, if a laminate assembly requiring heating is significantly narrower than the maximum available width of the heating zone, adjustable shielding means may be provided to reduce the width of the aperture so that it is only just wider than the laminate assembly.

Therefore the electromagnetic radiation can be concentrated in an area where it is required. When the waveguide is rectangular in transverse section the aperture is located in the shorter side of the rectangle which is adjacent the heating zone. Preferably the aperture of each waveguide is tapered so that heating effected by the radiation is more uniform along the length of the waveguide. The aperture may have an exponential slot width shape. There may be provided means to adjust the distance between the waveguide and the glass so that for different thicknesses of glass and PVB interlayer, the adjustment may be carried out to achieve optimum heating performance.

Preferably there are provided between adjacent waveguides radiation reflector means which act to contain the electromagnetic radiation to the heating zone. The radiation reflector means may consist of a plurality of horizontal metallic plates positioned between adjacent waveguides and running parallel therewith across the width of the heating zone. Each radiator reflector means may be made from any suitable electromagnetic reflecting material such as aluminium.

There is further provided means for transporting a laminate structure in a machine direction through the heating zone. This may consist of a plurality of electromagnetic radiation transparent or tolerant rollers arranged to support the laminate structure such that it does not come into contact with the waveguides as it passes through the heating zone. The rollers may be driven in a controlled manner to transport the laminate structure through the heating zone at a controlled rate. As the energy absorbed by the interlayer is a function of the incident radiation and the speed at which it travels through the heating zone, accurate control of the transport rate is important. Alternatively, other means for transporting the laminate structure may be utilised provided that it can controllably transport the laminate through the heating zone without interfering with the passage of electromagnetic radiation from the waveguides to the laminate structure.

There are further provided press means to compress the laminate structure after it has been heated. Preferably the press means consists of a pair of opposed rollers which force the upper and lower glass webs towards one another and so to force entrapped air either out of the laminate structure altogether or to dissolve it into the softened polymeric interlayer.

There may additionally be provided a dummy load proximate the ends of the waveguide opposite to those which have the electromagnetic radiation source positioned therein. The dummy load acts to absorb any surplus energy which has not been emitted from the waveguide by the time it reaches the end of the waveguide, particularly when there is no laminate assembly in the heating zone to absorb radiation. The dummy load is preferably a water load which is circulated throughout the apparatus. The dummy load may additionally be coupled to the sources of electromagnetic radiation to provide a cooling medium.

There may also be provided shielding means around the waveguides, heating zone and transport means so that any stray incident radiation which is not absorbed by the laminate structure or dummy load is contained within the shielding until it is ultimately absorbed by a load.

It will now be convenient to describe the invention with reference to a preferred embodiment shown in the accompanying drawings. It is to be understood that the drawings and the following description relate to a referred embodiment only and are not intended to limit the scope of the present invention.

Figure 1 is a plan view of a portion of the heating apparatus according to one embodiment of the present invention and showing only a portion of each waveguide.

Figure 2 is an end elevation of an apparatus according to the present invention.

Figure 3 is a side elevation of a complete apparatus of the present invention.

Figure 4 is a plan view of a typical waveguide as seen facing the heating zone.

Apparatus 1 consists of a plurality of applicators typically shown as 3 and 5. Each applicator consists of a waveguide 7 having at one end a magnetron 9 and at a tuning end 10 tuning rods 11 and 13. Each waveguide 7 has a radiating region 15, the radiating regions of all waveguides collectively forming a heating zone 17. Radiating region 15 of waveguide 7 has an aperture 19 facing into heating zone 17. Each magnetron 9 is connected to a variable power source (not shown). When energised, magnetron 9 generates travelling waves of microwave radiation which are reflected by the inside walls of waveguide 7 and travel in the direction of tuning end 10. Microwave radiation is emitted from aperture 19 into heating zone 17. In one embodiment of the invention (not shown) there may be provided adjustable shutter means to vary the aperture 19 and thus adjust the amount of radiation emitted therefrom.

To absorb any radiation which reaches the tuning end 10 of waveguide 7 there is provided a water conduit 21 which flows in series throughout the tuning ends of all the waveguides. Water is passed through conduit 21 and out of the apparatus whereupon the absorbed heat is dissipated. The water conduit 21 may also flow adjacent to magnetron 9 to provide cooling.

In Figure 3, conveyor rollers 23a to d can be seen supporting laminate structure 27 between upper waveguides 29a to c and lower waveguides 33a to d. Laminate structure 27 consists of a lower glass sheet 37, interlayer 39 and upper glass sheet 41 which are arranged in a sandwich configuration. Horizontal radiation reflectors 30a and 30b are provided between upper waveguides 29a and 29b, and 29b and 29c respectively. Horizontal radiation reflectors 31a, 31b and 31c are provided between lower waveguides 33a and 33b, 33b and 33c, and 33c and 33d respectively.

Laminate assembly 27 is layed up in "sandwich" arrangement and positioned on lead-in rollers 43 whereupon it is conveyed into the heating

apparatus 1. Heating apparatus 1 is substantially completely encapsulated by electromagnetic shielding 45 to prevent leakage of microwave radiation. The shielding may consist of metal foil, metal sheets or the like or any other material known in the art which reflects microwave radiation. Energy is supplied to the magnetrons to cause microwave radiation to be emitted from apertures 19 in waveguides 7 into heating zone 17. As laminate structure 27 travels through heating zone 17 interlayer 39 absorbs microwave radiation and is heated to a temperature to achieve PVB plastic flow, for example in the range of 120° to 150°C although lower temperatures may be sufficient to achieve plastic flow of the PVB. The laminate structure is then conveyed out of apparatus 1 and through press rollers 47 and 49 which act to cause absorption of any entrapped gas into the interlayer and to promote an even thickness of the interlayer. The laminate structure then passes through to end rollers 51 whereupon it can be handled and dispatched after cooling. Thus the invention has the advantage of enabling satisfactory laminated glass to be produced without the high capital cost associated with the use of autoclaves, or the high labour and material costs associated with the "resin-pour" process described above.

It is to be understood that various modifications, additions and/or alterations may be made to the parts previously described without departing from the ambit of the present invention.

CLAIMS

1. A method for manufacturing a glass laminate structure comprising the steps of:

a) providing an assembly including first and second glass sheets having therebetween an interlayer of polymeric material capable of being selectively heated, said sheets and interlayer being in a parallel sandwich arrangement;

b) passing said assembly through a heating zone whereby said assembly is exposed to electromagnetic radiation of a frequency or frequencies to selectively heat said interlayer to a fluid state;

c) passing said assembly through press means to affect laminating of said first and second sheets while said interlayer is still in a fluid state.

2. A method according to claim 1 wherein said electromagnetic radiation is microwave radiation.

3. A method according to claim 1 or 2 wherein said heating zone includes a plurality of waveguides emitting said electromagnetic radiation, said waveguides being spaced from each other in the direction of travel of said assembly and extending across the width of said assembly.

4. A method according to any one of claims 1 to 3 wherein said assembly is passed through said press means before said interlayer has lost any significant amount of heat by conduction to said first and second glass sheets.

5. A method according to any one of claims 1 to 4 wherein said press means comprise a pair of opposed rollers.

6. A method according to any one of claims 1 to 5 wherein said interlayer is heated to a temperature where plastic flow occurs.

7. A method according to claim 6 wherein said temperature is between about 80°C and 105°C.

8. A method according to any one of claims 1 to 7 wherein said interlayer is comprised of polyvinylbutyrate.

9. A laminated glass structure including first and second sheets laminated together by a polymeric interlayer wherein said structure is made by a method of any one of claims 1 to 8.

10. Apparatus for manufacturing a glass laminate structure including;

at least one source of electromagnetic radiation;

a plurality of waveguides traversing a heating zone in a cross-machine direction and spaced from each other along a machine direction in said heating zone, said waveguides carrying a travelling wave of microwave radiation from said source and having means for emission of said radiation from said waveguides into said heating zone;

means for transporting a laminate structure in a machine direction through said heating zone; and

press means beyond said heating zone to press said laminate structure after passage through said heating zone.

11. Apparatus according to claim 10 wherein said electromagnetic radiation is microwave radiation.

12. Apparatus according to claim 11 wherein each waveguide is provided with a source of microwave radiation.

13. Apparatus according to claim 11 wherein a waveguide is coupled to an adjacent waveguides in a region outside the heating zone such that radiation is propagated at said source positioned at one end of one waveguide and passes along said waveguide and is then redirected along said adjacent waveguide.

14. Apparatus according to any one of claims 11 to 13 wherein said source of microwave radiation is one or more magnetrons.

15. Apparatus according to any one of claims 11 to 14 wherein said waveguides are provided above and below said heating zone.

16. Apparatus according to claim 15 wherein said waveguides are

arranged in a staggered configuration in said machine direction.

17. Apparatus according to any one of claims 11 to 16 wherein said there are provided a plurality of sources of microwave radiation positioned alternately at the sides of said heating zone.

18. Apparatus according to any one of claims 10 to 17 wherein said means for emission of said radiation consists of an aperture extending along the waveguide in the region of said heating zone.

19. Apparatus according to any one of claims 10 to 18 wherein said press means consists of at least one pair of opposed rollers.

20. A method substantially as hereinbefore described with reference to the example.

21. Apparatus substantially as hereinbefore described with reference to any one of the Figures.

1/3

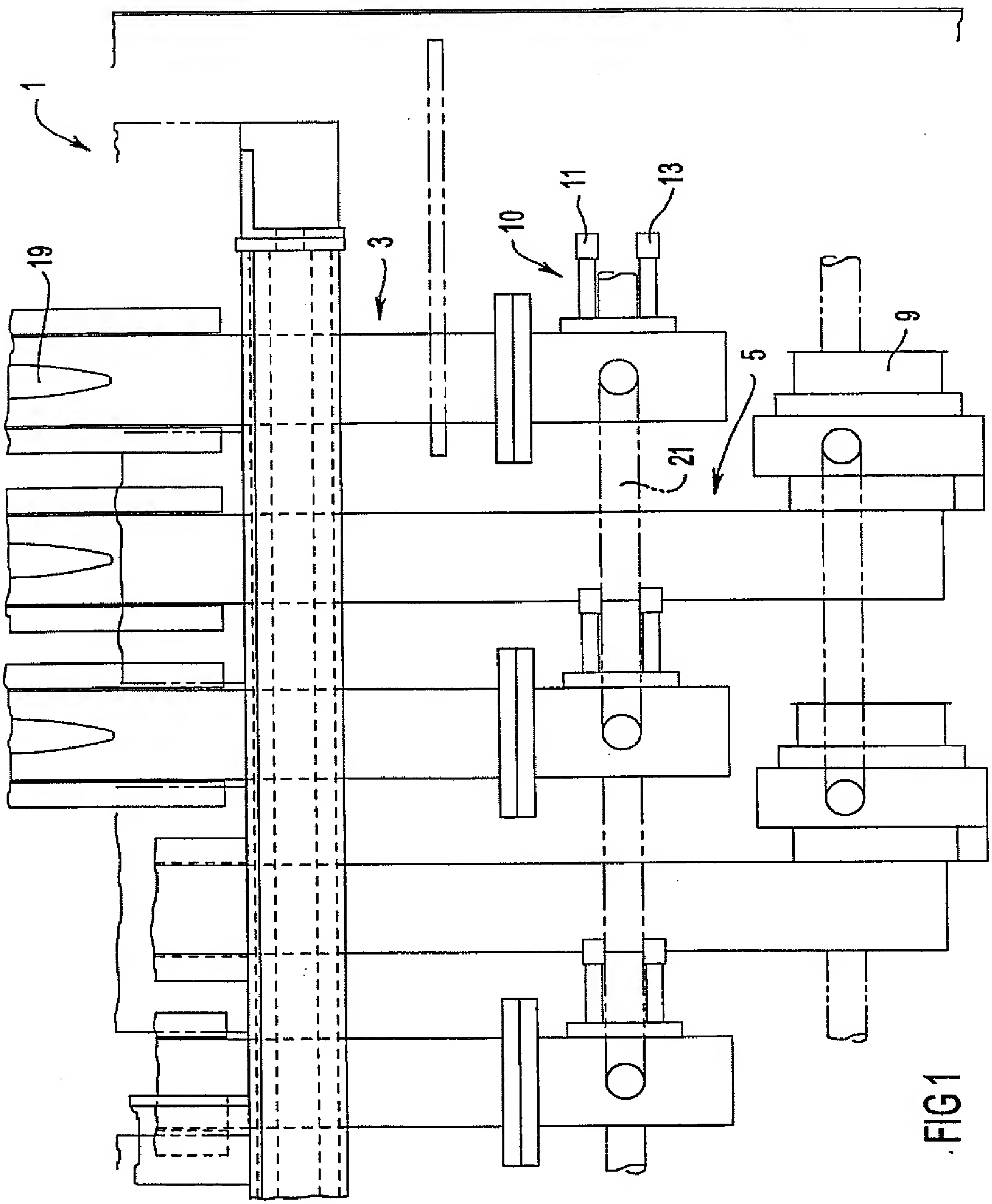


FIG 1

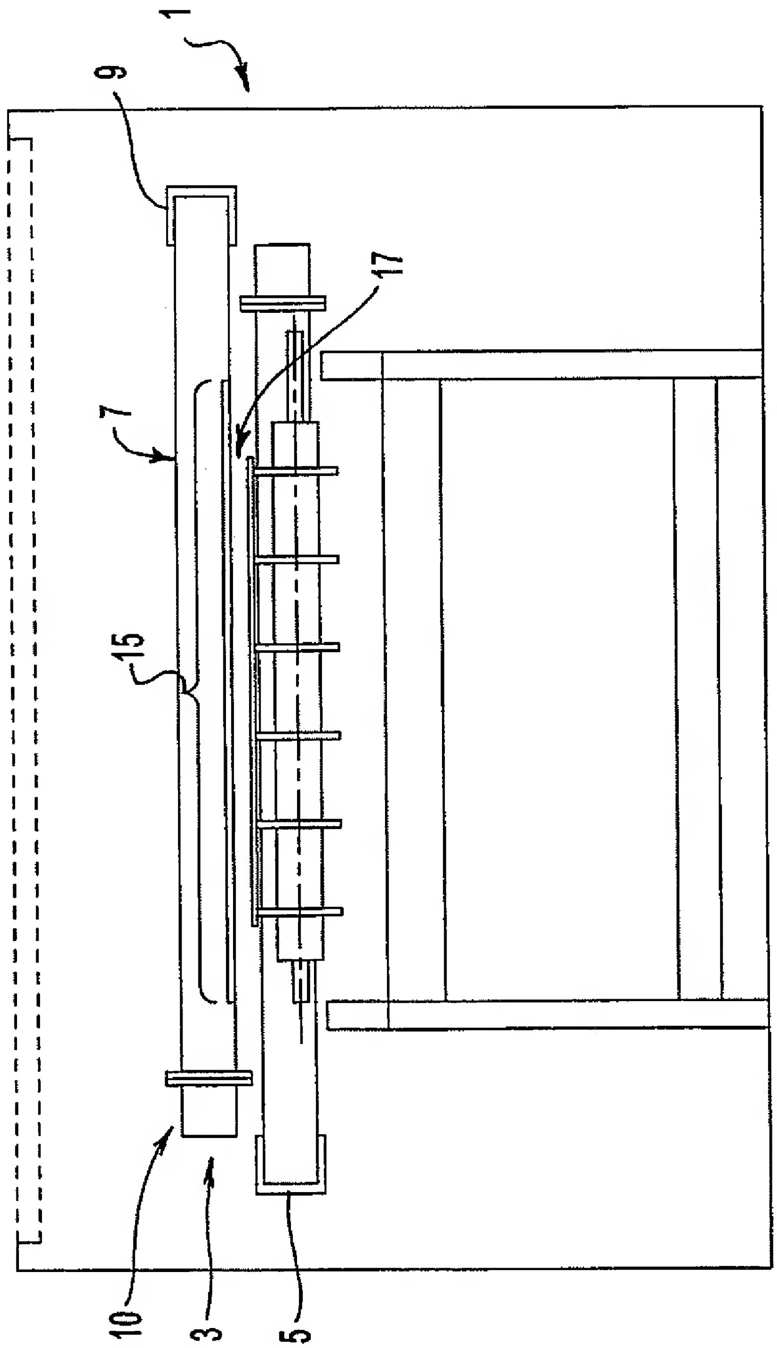


FIG 2

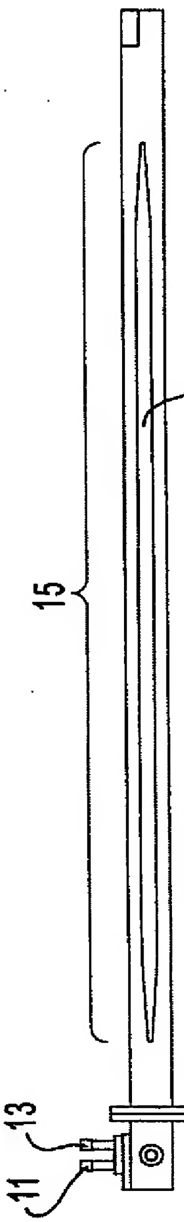


FIG 4

3/3

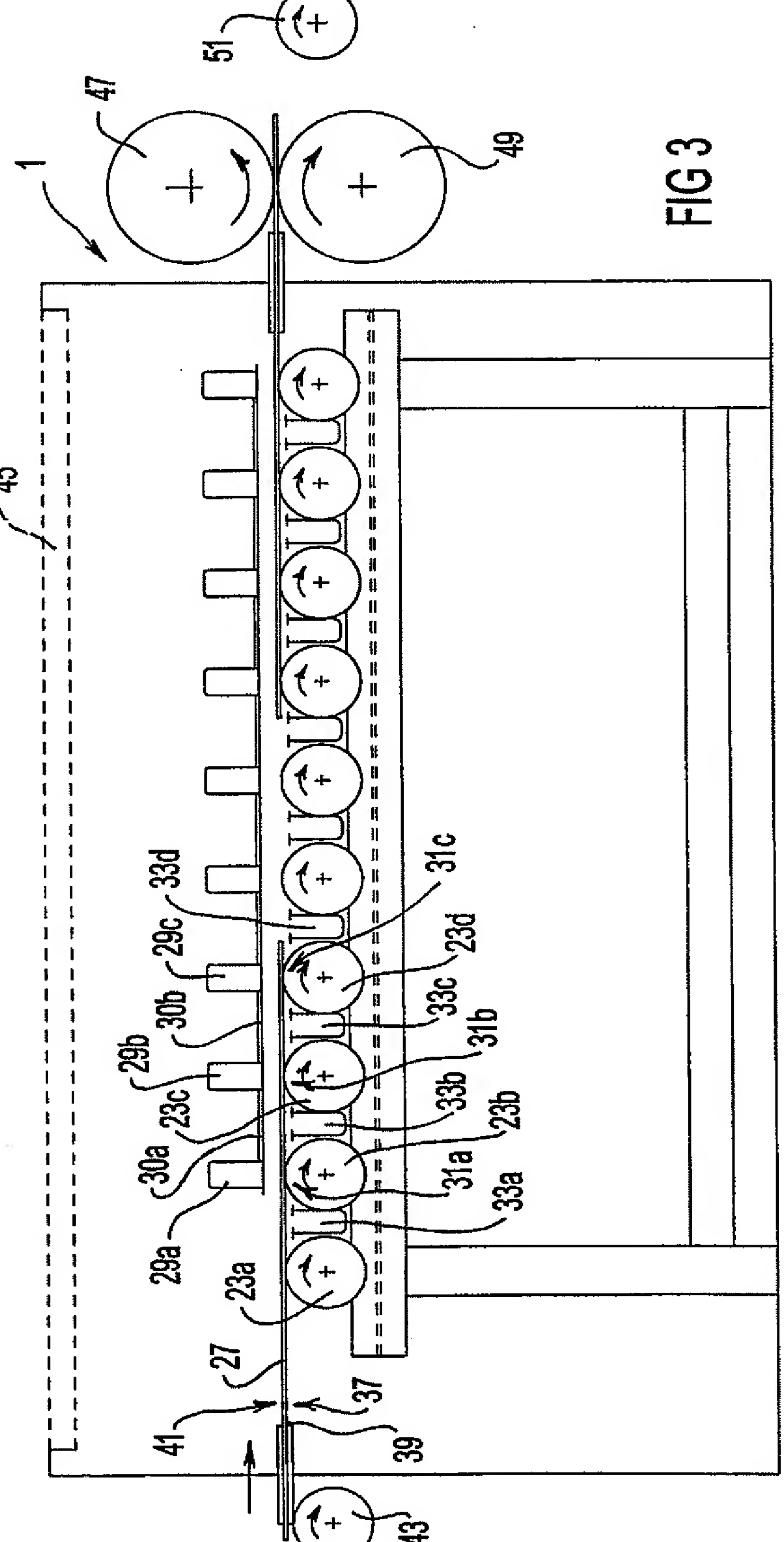

1
45
47
49
51
43
41
39
37
27
23a
29a
30a
23c
29b
30b
29c
33d
31c
23d
33c
31b
33b
23b
31a
33a

FIG 3

INTERNATIONAL SEARCH REPORT

International Application No.
PCT/AU 98/00150

A. CLASSIFICATION OF SUBJECT MATTER

Int Cl^{6}: C03C 27/12, B32B 17/10, 31/04, 31/26

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC C03C 27/12, B32B 17/10, 31/04, 31/26

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
AU: IPC as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
WPAT: Electromagnetic or infrared or microwave

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 88/03517 A (FINCH) 19 May 1988	1-21
A	EP 0 285 572 A (SOCIETA ITALIANA VETRO SIV. SPA.)	1-21
A	DE 19650310 A (SCHAFER) 4 December 1996	1-21

☐ Further documents are listed in the continuation of Box C

☒ See patent family annex

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search 3 April 1998	Date of mailing of the international search report 16 APR 1998
Name and mailing address of the ISA/AU AUSTRALIAN PATENT OFFICE PO BOX 200 WODEN ACT 2606 AUSTRALIA Facsimile No.: (02) 6285 3929	Authorized officer G. CARTER Telephone No.: (02) 6283 2154

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No.
PCT/AU 98/00150

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report		Patent Family Member					
EP	285572	CA	1300871	JP	63256550	US	4865874
WO	8803517	AU	81771/87				

END OF ANNEX